

## Viscosity of secondary organic material and implications for particle growth

JAMES W GRAYSON<sup>1\*</sup>, LINDSAY RENBAUM-WOLFF<sup>1</sup>,  
MIJUNG SONG<sup>1</sup>, KATIE POTTER<sup>1</sup>, MIKINORI KUWATA<sup>2</sup>,  
ADAM P BATEMAN<sup>3</sup>, YUE ZHANG<sup>3</sup>, PENGFEI LIU<sup>3</sup>,  
MATHIEU SELLIER<sup>4</sup>, BENJAMIN J MURRAY<sup>5</sup>,  
JOHN SHILLING<sup>6</sup>, SCOT T MARTIN<sup>3</sup>  
AND ALLAN K BERTTAM<sup>1</sup>

<sup>1</sup>University of British Columbia, Vancouver, Canada

(\*correspondence: Grayson@chem.ubc.ca)

<sup>2</sup>Nanyang Technological University, Singapore

<sup>3</sup>Harvard University, Cambridge, USA

<sup>4</sup>University of Canterbury, Christchurch, New Zealand

<sup>5</sup>University of Leeds, Leeds, United Kingdom

<sup>6</sup>Pacific Northwest National Laboratory, Richland, USA

Aerosols are a ubiquitous component of the atmosphere and are a large source of uncertainty in climate models. Aerosols composed of secondary organic material (SOM) comprise a significant fraction of the aerosol mass in the troposphere. However, despite its importance, knowledge about the physical properties of SOM remains limited.

Whilst SOM particles are often modeled as liquids, recent studies have suggested particles consisting of SOM may exist in the semi-solid or solid phases, especially at low relative humidity (RH). Semi-solid and solid particles – those of high viscosity – could have kinetic limitations upon the amount of material they can uptake, and thus the size to which they can grow. As such, knowledge as to the viscosity of SOM may aid in improving the accuracy of climate models.

SOM from the atmosphere or atmospheric simulation chambers are typically available on the milligram scale and their viscosities can span numerous orders of magnitude. As a result, currently available commercial viscometers are unsuitable for studying the viscosity of SOM. Presented here are two novel techniques that have been developed to measure the viscosities of SOM samples. The first is a bead mobility technique, where small (~1  $\mu\text{m}$ ), insoluble beads are observed as they circulate within 20-50  $\mu\text{m}$  SOM particles. The second is a poke-flow technique, whereby 20-70  $\mu\text{m}$  SOM particles are poked with a needle, and the flow rate of these particles after poking is used to determine viscosity. These techniques not only provide visual evidence that atmospheric samples behave as semi-solids or solids, but also quantitative information as to their viscosities. Results from studies with SOM produced by the ozonolysis of  $\alpha$ -pinene, the photooxidation of toluene, and the photooxidation of isoprene will be presented.